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Source: Mountain Research and Development, 36(4) : 494-505

Published By: International Mountain Society

URL: <https://doi.org/10.1659/MRD-JOURNAL-D-16-00034.1>

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The Effects of Migration on Livelihoods, Land Management, and Vulnerability to Natural Disasters in the Harpan Watershed in Western Nepal

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Migration is increasing in the middle hills of Nepal, and it has diverse consequences for the people remaining behind, their livelihoods, and the way they manage their land. This study explored

the complex and interrelated effects of migration on land and people in the Harpan watershed, Kaski District, western Nepal. Surveys and focus group discussions were used to explore the reasons for decisions on land management and migration. In addition, remote sensing and fieldwork were used to map the extent of land abandonment. Our study found that almost three quarters of the households have at least 1 migrant member

receiving on average US\$ 206 per month in remittances. Remittances were used mainly for food and goods and to a much lesser extent for agriculture. In addition to international migration, substantial migration occurs within the area. Once livelihoods permit, whole families choose to migrate to market areas, from uphill to downhill communities. This has led to land abandonment and an increase in forest cover in the upper part of the watershed and has also increased pressure on the land and exposure to flooding in the lower part.

Keywords: Migration; land management; livelihoods; left-behind population; land use; flood; Nepal.

Peer-reviewed: August 2016

Accepted: September 2016

Introduction

An increasing number of people worldwide are migrating to improve or secure their livelihoods, and mountain regions play an important role in this trend. Migration is often the result of a combination of push factors (eg conflict, poverty, disaster) and pull factors (eg job opportunities) (Stark and Bloom 1985; Massey et al 1993). In Asia, smallholder farmers have increasingly diversified their livelihoods in the past decades, usually by finding employment in the same area or by migrating (Rigg et al 2016).

Remittances from migrants are an important source of income in many developing nations, at both country and household levels, especially in mountain areas (World Bank 2016). They change household consumption patterns and create “remittance landscapes.” In some Asian countries such as the Philippines, paddy fields have been replaced by cash crops, such as beans, due to labor and water shortages (McKay 2005).

In Latin America, several studies have focused on environmental conditions and migration (Gray 2009) as well as on migration and its positive impacts on land management and land use (Radel and Schmook 2008; Schmook and Radel 2008; Davis and Lopez-Carr 2014). In the Caucasus, Gracheva et al (2012) reported on settlements that have been semiabandoned due to migration, and in the Alps, Gellrich et al (2007) studied the recovery of the ecosystem as a consequence of land abandonment.

In Nepal, outmigration and its effects on livelihoods are key topics in the scientific and policy debates. This is due to the unprecedented increase in outmigration for foreign employment over the past decades, which has resulted in remittances representing as much as 29% of the national gross domestic product (World Bank 2016). India, due to its open border (since 1952) and cultural similarities, was until recently the main destination for decades for Nepali migrants (Government of Nepal 2014b). In Nepal, a number of factors—decentralization of passport services after the restoration of democracy in

1990, national policies supporting labor migration (Foreign Employment Act 1985), liberal economic policies, and the construction boom fostered by the oil industry and related sectors—have accelerated the flow of Nepali labor migrants into Arabian Gulf countries as well. The 2011 national census found that about 7% of Nepal's population (1.9 of 26 million) was absent from the household (away for more than 6 months or not expected to return for at least 6 months). Migrants from Nepal were mostly (87.6%) men in 2011 (Government of Nepal 2014b). Of Nepal's population, 82.9% live in rural areas. Agriculture is the main employment of 60% of the rural population (Government of Nepal 2014b).

Blaikie et al (2002) studied the transformation of rural space due to the increase in off-farm income and migration over 20 years and found no major changes in agriculture (such as commercialization of agriculture or rapid economic growth). Maharjan et al (2013) explored the impact of migration on labor and nonlabor inputs and production outputs in rural farm families in Syangja and Baitadi Districts in the hills of Nepal. Their findings suggested neglect of subsistence farming with access to alternative sources of income and a preference for livestock raising over crop farming. Other studies have found increasing feminization of the agricultural sector, and an increasing workload for women, but also signs of empowerment (Gartaula et al 2010; Adhikari and Hobley 2011; Gartaula et al 2012b; Sharma and Thapa 2013; Tamang et al 2014).

Several studies have looked at the impacts of remittances (Seddon et al 1998; Kollmair et al 2006; Sherpa 2010; Maharjan et al 2012; Sapkota 2013), while others have looked in more depth at changes in livelihoods (Adhikari and Hobley 2011; Gartaula et al 2012a) and poverty dynamics (Sunam and McCarthy 2015). However, less research has been done on the effects of migration (and the resulting reduction in labor availability) on land resources and land management (Khanal and Watanabe 2006). This would require a study linking the human and ecological systems, which, according to Hecht et al (2015), are often disconnected due to different scales of analysis.

The interrelations between the social and ecological systems may be understood by applying the sustainable livelihoods approach. This approach dates back to the 1990s. Several studies influenced its development, such as the work of Sen (1981) on entitlement and the work of Chambers and Conway, who proposed a first definition of sustainable livelihoods in 1992. This definition stated: "A livelihood comprises the capabilities, assets (including both material and social resources) and activities for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base" (Scoones 2009: 175). The Sustainable Livelihood Framework was

promoted by UK's Department for International Development in 1999 (De Haan 2012). Widely accepted by the development community, the approach was used by a range of scholars, programs, and projects. However, it was also criticized, especially regarding its failure to take power relations into account, its approach to poverty, and its usability. Over the years, scientists have tried to include these missing elements in their research on livelihoods. The framework, although still useful, would need to be adapted to current developments in research and to new issues (Scoones 2009).

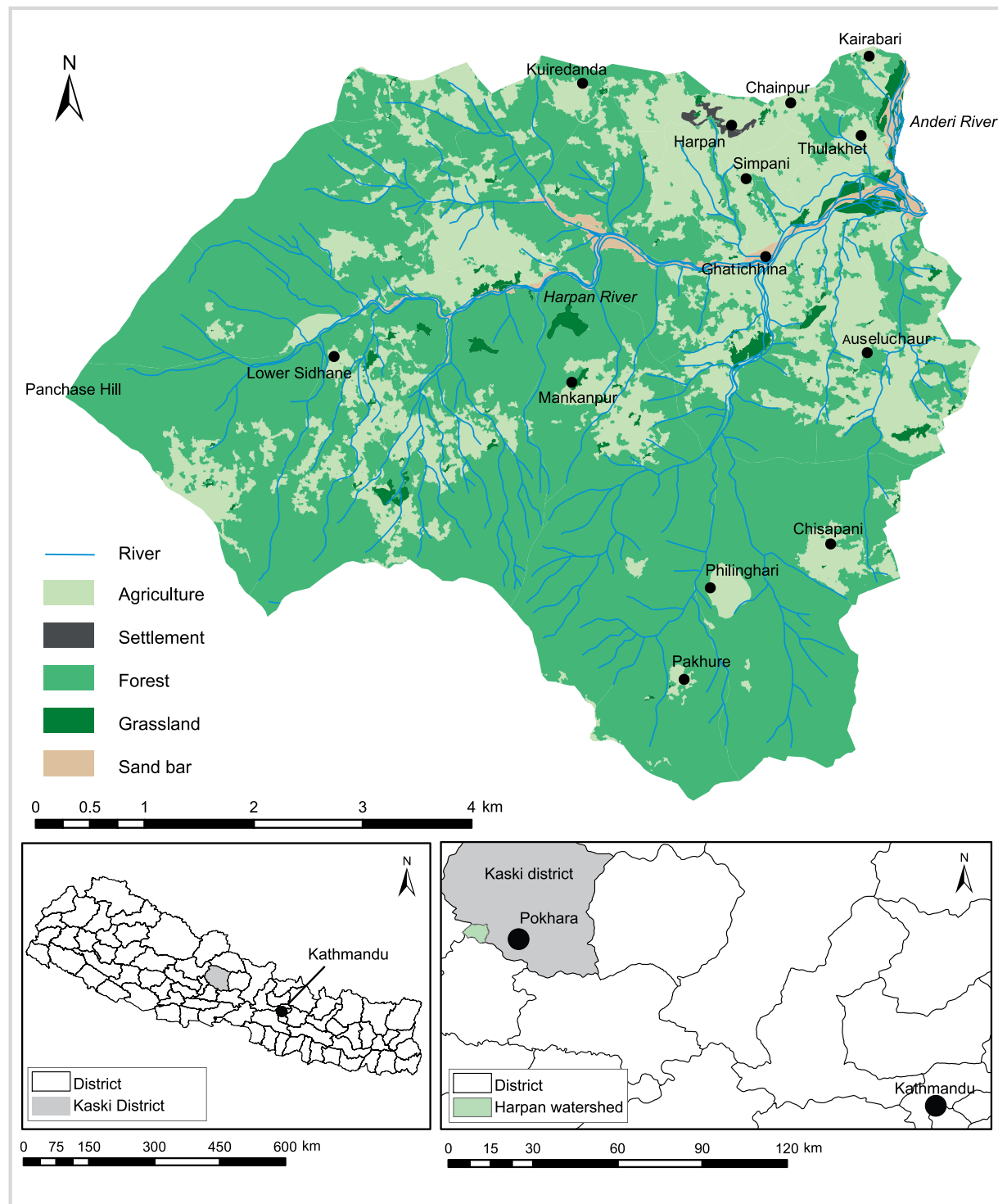
The objective of this study was to explore the complex and interrelated effects of migration on people and land. The work was based on 2 main hypotheses: (1) that the pressures on resources shift from outmigration areas to in-migration areas in the context of diversification of income, including labor migration, and (2) that the economic benefits that are expected from those types of migration come at the expense of increased land degradation and higher exposure to natural hazards. This article discusses—for the uphill (mountain slopes) and downhill (valley bottom) areas of the watershed—the extent of and motives for migration; its effects on the livelihoods of those remaining behind, particularly women; changes in land management caused by migration; and the opportunities and risks related to these changes. What this article explicitly does not engage with is a detailed analysis of the role of ethnicity in people's livelihood choices. We acknowledge the importance of the issue of ethnicity in research on migration and land management; but the question in itself would require another approach and methodology as well as the space of an additional article.

Study area

The study area, the Harpan watershed, is in Kaski District in Nepal, west of Pokhara Sub-metropolitan City (Figure 1). Elevation ranges from 825 m above sea level (masl) in Thulakhet village in the east to 2517 masl at the top of Panchase Hill in the west. The watershed comprises the upper part of the Harpan River, which flows west to east and is the major source of water for Phewa Lake near Pokhara. The area is inhabited by people of diverse ethnicities and castes in 21 communities with an average of 5 people per household (Intensive Study & Research Centre 2012).

The Harpan watershed is well suited to this study because of its diverse topography and land use and migration patterns. It has high rates of outmigration, as commonly found in the middle hills of western Nepal (Government of Nepal 2011). Migration within the watershed is also important due to the topography of the area, with high slopes and a flat valley floor with access to the main city. This socioecological diversity makes it

FIGURE 1 Land cover and location of the Harpan watershed. (Map source: Ikonos satellite image)



possible to explore the impacts of out- and in-migration on the land resources within a small watershed.

The watershed has seen major natural disasters in the last century—including an earthquake in 1934 that

triggered a large landslide, a 1958 earthquake that also triggered landslides, and heavy rains in 2007 that flooded part of Ghaticchhina village. An April 2015 earthquake caused little damage but was followed in July 2015 by

TABLE 1 Characteristics of the study villages. (Table continued below.)

Village	Location	Migration	Land abandonment ^{a)}	Land degradation ^{a)}
Ghatichhina	Downhill	Immigration from uphill; significant outmigration	2	4
Thulakhet	Downhill	Immigration from uphill; significant outmigration	2	4
Kuiredanda	Uphill	High outmigration	5	3
Harpan	Uphill	Medium outmigration	1	3
Lower Sidhane	Uphill	High outmigration	5	2
Mankanpur	Uphill	High outmigration	5	2
Chisapani and Philinghari ^{d)}	Uphill	High outmigration	2	2

TABLE 1 Extended. (First part of Table 1 above.)

Village	Accessibility	Caste/ethnicity	Households in village	Households surveyed
Ghatichhina	Frequent daily buses	Mixed	26	13
Thulakhet	Frequent daily buses	Mixed	59	12
Kuiredanda	Road but no bus	Low caste	21 or 12 ^{b)}	7
Harpan	Daily bus	Mainly Brahmin	148 ^{c)}	31
Lower Sidhane	Daily bus	Gurung and low caste	21	9
Mankanpur	Road but no bus	Gurung and low caste	27	9
Chisapani and Philinghari ^{d)}	Daily bus to Chisapani; 30-minute walk from Chisapani to Philinghari	Mixed	24	8

^{a)} 1 = very little; 5 = a lot.

^{b)} During the collection of information on the villages, 21 households were counted in Kuiredanda. During the demographic survey, only 12 households were counted. This might be due to an error. However, the village of Kuiredanda is experiencing a high migration of whole families and is emptying quickly due to high outmigration, lack of land ownership, and unsuitability for cultivating the land.

^{c)} Harpan was not chosen for a demographic survey for logistical reasons.

^{d)} Philinghari has only 6 households; it was surveyed together with the nearby village of Chisapani.

heavy rains that triggered flooding and mudflows in the lower watershed, destroying bridges and houses and killing 8 people in Ghatichhina and Thulakhet villages.

Methods

We chose the Sustainable Livelihoods Framework (DFID 1999) as an analytical framework, as it is considered a standard approach to understand livelihoods and vulnerability in development contexts of this kind (Upreti and Müller-Böcker 2010). Data collection relied mainly on qualitative methods described later; in addition, we conducted a review of reports and the literature.

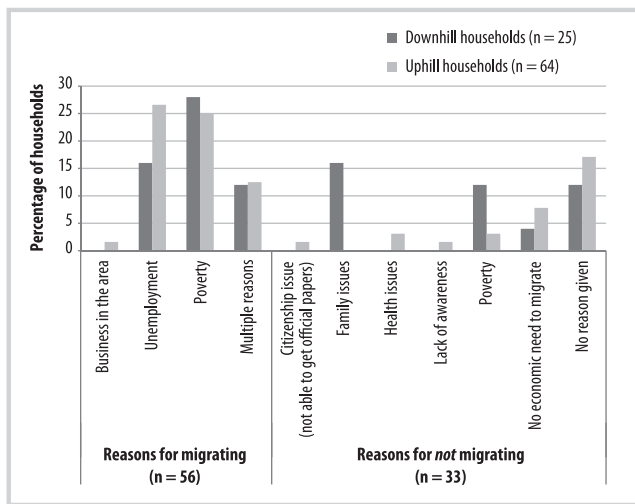
Local residents were interviewed during field visits in 2013 and 2014 with the help of staff members from local nongovernmental organizations, leaders of community forest groups, and social workers. First, a list was compiled of the 21 villages in the watershed with information on a number of qualitative criteria:

- Location on the valley bottom (downhill) or on the slopes (uphill)
- Extent of migration, defined as absence from the home for more than 6 months, by household members;
- Extent of land abandonment, defined as disuse for more than 2 consecutive years;
- Extent of land degradation, defined as soil erosion or biological or chemical deterioration of the soil or water;
- Accessibility, in particular the presence of public transport;
- Ethnicity/caste of residents, with attention to homogeneity or heterogeneity within a village.

Seven villages (with a total of 317 households) representing different combinations of these criteria were chosen for further study (Table 1). Two surveys were then conducted.

A demographic survey asked the households (N = 169, excluding Harpan village for logistical reasons) about

FIGURE 2 Reasons for decisions on whether to migrate. (Source: household survey)



household members' age, sex, migration status, and (for migrants) destination and type of work.

Next, in a smaller, more in-depth household survey ($N = 89$) designed to elicit as much information about the 5 capitals as possible, we attempted to reach every third household in each of the 7 study villages (including Harpan), using village topographic maps to ensure inclusion of outlying households and ethnic clusters and to take socioeconomic differences into account. However, in some villages we were unable to reach one-third of the households because household members were unwilling to participate or were absent.

Next, focus group discussions were held (2 each in Ghatichhina, Mankanpur, Lower Sidhane, and Chisapani; 1 each in Kuiredanda and Harpan) to explore the reasons for decisions on land management and migration as well as to understand the consequences of migration and the changes it entails for households and women with regard to labor, social contacts, land use, and household responsibilities. The discussions aimed at covering the topics that were not elaborated in the household survey. For the focus group discussions, participants were chosen based on a purposeful sampling with the help of some key respondents. Separate focus groups for men and women were held whenever possible to ensure the participation of both and to provide women with a comfortable space to express their views and experiences.

Data on current hazards and damage were collected in August 2015 through field observations, the Global Positioning System, and informal interviews.

Categorical and numerical data from the demographic and household surveys were analyzed using SPSS (Statistical Package for the Social Sciences). Communities were grouped according to their location, the criterion identified as the most suitable for our analysis due to the topography of the watershed. A geographic information

system was used for spatial analysis of migration and of changes in land use between 1978 and 2014.

Analysis of the qualitative and quantitative data collected was based on the Sustainable Livelihood Framework to elucidate the 5 capitals in the following way:

1. *Human capital* was analyzed using indicators derived from information provided in the in-depth survey and focus group discussions on reasons for migrating and on the advantages and disadvantages related to migration. In addition, data on education and access to education as well as on type of occupation were used.
2. *Social capital* was assessed through focus group discussions; it covered items such as consequences of migration for households and women based on information regarding networks, membership in organizations, and decision-making power.
3. *Financial capital* was assessed with the help of data on the amount and use of remittances as well as on type of income.
4. *Natural capital* was elucidated based on information about land use, number and type of crops, land degradation, and natural hazards.
5. *Physical capital* was assessed based on data regarding housing, infrastructure, and access to electricity, water, and sanitation.

Results

Two types of migration exist in the watershed: outmigration, mostly of individual men to other parts of Nepal and abroad, and internal migration of whole families from uphill to downhill locations within the watershed. The 2 are closely linked, as the migration of 1 member facilitates the migration of the whole family.

Male outmigration

In households participating in the demographic survey, most people who migrated individually were men 20–40 years old who moved primarily for economic reasons, for example, poverty or unemployment. Migrants who leave Nepal now go primarily to Qatar. Of those who stay in Nepal, a majority remain within Kaski District (mainly moving to Pokhara, Nepal's second city).

There was little difference between uphill and downhill communities in the reasons for migration. By contrast, a greater variety of reasons were given for *not* migrating; in addition to economic issues these reasons were poor health, family issues, and lack of awareness about migration (Figure 2). Poverty affected people from all communities without any distinction between ethnic groups. Families must often borrow a substantial amount of money—from relatives, community organizations, or financial institutions—to pay for migration.

TABLE 2 Main sources of income. (Source: household survey, N = 89)

Income source	Downhill households (n = 25)	Uphill households (n = 64)
Agriculture	20.0%	35.9%
Business	0.0%	1.6%
Wage labor	0.0%	1.6%
Pension	4.0%	1.6%
Help from family	4.0%	1.6%
Work as a tailor	0.0%	3.1%
Teaching	4.0%	1.6%
Remittances	32.0%	25.0%
Mixed (unspecified)	36.0%	26.4%
No answer	0.0%	1.6%

Compensation (eg land) and interests thereafter are important constraints for the poorest households. A key informant who worked with a nongovernmental labor agency said that it costs US\$ 700–800 to go to a Gulf country; Sunam and McCarty (2015) reported a cost of US\$ 700–1500 to go to a Gulf country or Malaysia. Others have reported an average cost of US\$ 1250 for international migration (Hagen-Zanker et al 2014).

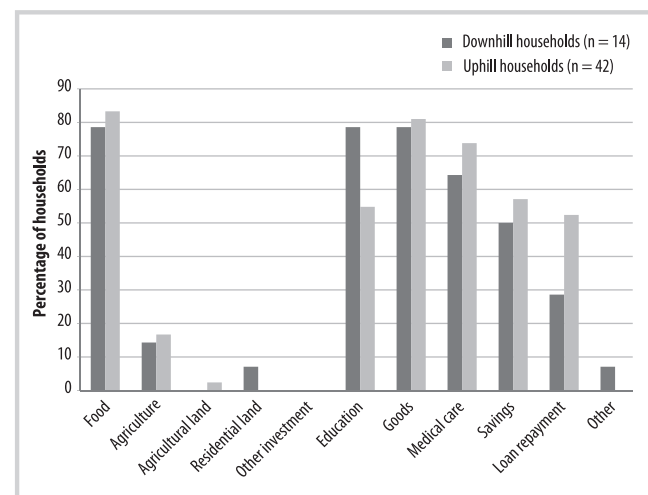
Several men from Kuiredanda village said that they would not migrate to earn money to educate their children, for example, if the villages had better infrastructure and access to facilities. As one focus group participant said, “We don’t have hospitals [or] good schools here, so we are compelled to go.”

One consequence of outmigration is a severe shortage of men in some villages, with sex ratios as low as 6 men to 10 women in the permanent population.

Remittances and diversification of income

Just under a third of all households still mentioned agriculture as their main source of income. Downhill households received relatively less income from agriculture and more from mixed sources and remittances than their uphill counterparts (Table 2). This is because downhill households find it easier to diversify their income due to better road connections. Remittances were received by about 58% of households and were the main source of income for a quarter of uphill and a third of downhill households. Monthly amounts average NPR 20,632 (US\$ 206)—much higher than the nationwide average of US\$ 67 (Government of Nepal 2011)—and range from NPR 2083 (US\$ 20) to NPR 80,000 (US\$ 800). Remittances are mainly used to buy food and goods (Figure 3).

Downhill communities use a greater proportion of remittances for education than uphill communities. If

FIGURE 3 How households spent remittance funds; each household could choose up to 5 options. (Source: household survey)

remittances allow, children are often sent to costly private English-language schools in the valley, where the quality of education is perceived to be better. Gartaula et al (2012b) also mentioned the importance for migrants’ families of sending the children to higher quality schools.

Few households invest in agricultural supplies and even fewer in agricultural land.

Consequences for the women remaining behind

Migration also affects the family structure. In a traditional Nepali family, the wife takes care of the house, children, and livestock. When her husband is away, she has to manage the land and make important decisions that he would usually make. Women focus group participants said that they call their husbands abroad for some decisions but often have to make decisions themselves.

On the other hand, women are increasingly dependent on male wage labor for plowing. Local Hindu traditions forbid women to plow and roof, and if they undertook such tasks, they could be accused of creating misfortune for the village. With high demand and fewer laborers available, wages in the villages are high—NPR 500–600 (US\$ 5–6) per day for men plowing the land or NPR 200–250 (US\$ 2–2.5) for women planting rice (Tamang et al 2014). This has an adverse impact on land management and agriculture, as a majority of the population remaining behind perceives agriculture as a low-return activity with high costs, including for time and labor. As a result, many limit their farming efforts to easily accessible fields and reduce the number of crops per year, as discussed in the next subsection.

Meanwhile, the importance of local organizations is increasing. Of the women respondents in the household survey, 83% said they participate in women’s, mothers’, agriculture, or finance groups. With the inflow of remittances, such groups are now able to buy supplies for

TABLE 3 Crop patterns and types of land. (Source: household survey, N = 89)

Type of land	Number and type of crops		Presence of crops by location	
	Irrigated land	Nonirrigated land	Downhill (n = 25)	Uphill (n = 64)
Mostly irrigated	1 (rice)	–	4.0%	0.0%
Mix of irrigated and nonirrigated	1 (rice)	1 (maize)	28.0%	9.4%
	1 (rice)	2 (eg maize, millet, mustard, or buckwheat)	28.0%	48.4%
	1–2 (rice, wheat)	2–3 (eg maize, millet, mustard, or buckwheat)	20.0%	6.3%
	1–2 (rice, wheat)	1–2 (eg maize, millet, mustard, or buckwheat)	12.0%	1.6%
Mostly nonirrigated	–	1 (maize)	0.0%	1.6%
	–	2 (eg maize, millet, mustard, or buckwheat)	0.0%	23.4%
	–	3 (eg maize, millet, mustard, or buckwheat)	0.0%	3.1%
No answer			8.0%	6.2%
Total			100.0%	100.0%

traditional ceremonies, maintain paths, build a temple, attend trainings, or provide loans.

Changing land use and cropland management

The average landholding size in the study area is 0.38 ha per household; the largest landholding, 3.05 ha, is in the lower part of the watershed. There is no major difference in landholding size between downhill and uphill villages, but there is a clear difference between ethnic groups, with the more marginalized usually owning the least.

Uphill households cultivate more crops on nonirrigated land. Downhill farming households all combine rice on irrigated land with an additional crop on nonirrigated land. Downhill households tend to cultivate up to 4 crops (Table 3). Potatoes are cultivated in all areas, but more so in downhill areas, where they are grown for home consumption and increasingly for sale. Overall, there is an intensification of land use in downhill areas, while uphill areas are characterized by a decrease of land management.

A man from Mankanpur said, “Before, people would cultivate wheat, barley, mustard, and so on in huge areas. Now ... many people have stopped cultivating them. This is because of migration. And old people are not capable of farming.”

Time and labor constraints, availability of remittances, and low productivity of the land can thus lead households to leave their land fallow or to stop investing in terrace maintenance and irrigation. This phenomenon has been already observed in several other regions of Nepal (Gartaula et al 2010, 2012b; Tamang et al 2014). But while many have stopped using their land, they have not sold it, as they expect to return to it in the future.

A woman from Mankanpur said, “Nowadays, even the lands nearest to houses are abandoned; the labor cost is huge and production is low. So it is better to use [remittance] money to buy necessities than to cultivate land.”

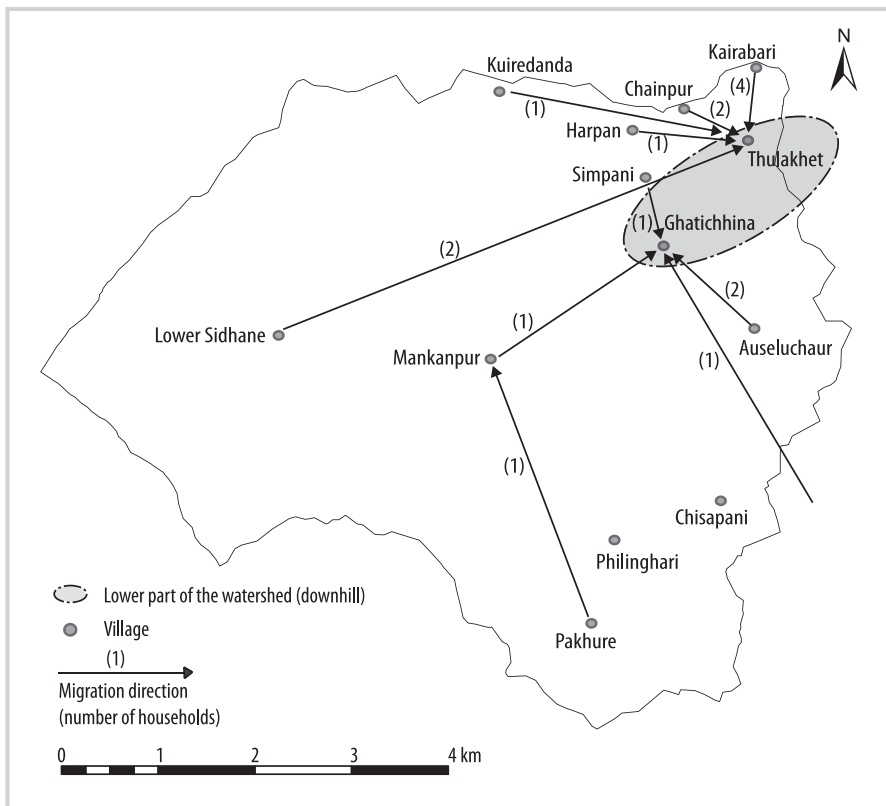
A man from Kuiredanda said, “The Gurung don’t sell their lands. They don’t have money problems; they don’t sell it. Even if we want to cultivate their lands, they don’t provide them to us. They are thinking of returning one day.”

Lands that are farther away or less suitable for farming are often abandoned first. The main cultivated areas are around the homesteads. A previous study in the area showed that cultivated terraced lands decreased in area by 36% between 1978 and 2014 (Jaquet et al 2015). Only 7.9% of the households interviewed rented land or used the traditional sharecropping system, *adhiya*. Respondents said that the *adhiya* system required too much work for the return received (one-half of the crop).

A man from Harpan said, “Most of the people have stopped cultivating the land. Only the aged remain behind. There is no irrigation during dry months. There is no road development, no quality education, no health facility, no state policy, all these have led to more urbanization.”

Due to favorable ecosystem recovery conditions, abandoned land turns into shrubland after 2 or 3 years and into forest after 5 to 10 years. Forested areas increased by 12.5% between 1978 and 2014—due to abandonment of private land, better management of the community forests, and the creation of a protected forest area. This has reduced the occurrence of landslides, gullies, and soil erosion (Jaquet et al 2015). The land use change has also had negative impacts, however, including an increased presence of invasive species, which spread

FIGURE 4 Internal migration within the watershed. (Source: household survey)



more quickly on land that is not harvested or weeded, and loss of soil fertility, mainly caused by the reduced supply of manure from livestock (Jaquet et al 2015).

Internal migration and exposure to natural hazards

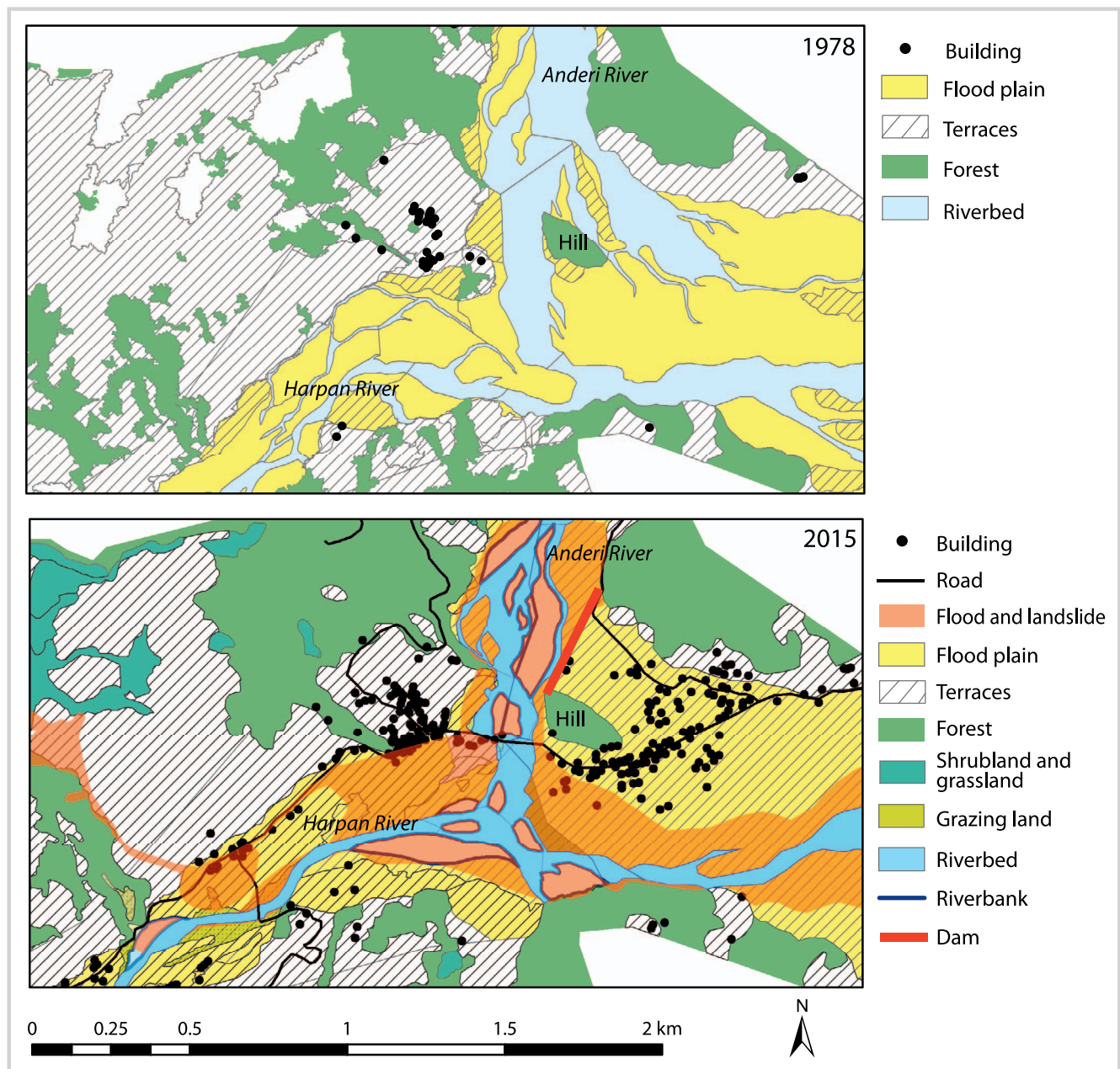
In addition to individual migration, whole families are moving from uphill to downhill areas (Figure 4), also leaving uphill land unused. In our study, 18% of the households interviewed in the household survey had made this move. Such families often move to the urban areas, if they have the means, to give their children better access to education and to be closer to health centers, bazaars, and jobs. Outmigration of one family member in pursuit of remittances sometimes enables the whole family to move downhill; in doing so, the family relies on the family member abroad for the money needed to invest in residential land. Some families moved as long as 45 years ago, and others moved 6 months before the household survey. Reasons given were not related to the time of the move. Some were young families separating from their parents, which they said is a relatively new phenomenon. Half of the families who moved were receiving remittances from family members who had migrated abroad; 31% had incomes from other sources such as agriculture, employment, or a shop. Only 2 families remained in the agricultural sector. In the past 10 years

the population in some uphill villages has declined by 50%.

Ghatichhina and Thulakhet, the 2 downhill study villages, have grown significantly since 1978, and what was then a flood plain and riverbed west of the Anderi River is now the newly settled area of Thulakhet and the site of markets, schools, roads, and agricultural fields. A dam was built to divert the Anderi River from flooding this newly settled area. However, in July 2015, a major flood destroyed about 31 ha of farmland, primarily rice and vegetable farms, almost 20 houses, and some animal sheds (Figure 5). West of Thulakhet on the same day, a landslide carried away 5 houses and killed 8 people. Figure 5 shows the change of land use between 1978 and 2015. Even though comparability between the maps is limited due to the lack of information available for 1978, the change of land use west of the Anderi River and the increase in forest in the northwestern part of the area—thus uphill—confirm the general trend of a shift of the population to the lower part of the watershed. This trend was confirmed in the interviews.

Village residents are aware of the flood hazard, as flooding has occurred in the past in the lower part of the watershed, including in Ghatichhina in 2007. Nevertheless, people continue to move downhill, building houses in the former riverbed and thus increasing the

FIGURE 5 Land use and land cover in 1978 and 2015 and flooding in 2015, Thulakhet village. (Map sources: 1978, aerial photograph, Department of Survey, Kathmandu; 2014, Ikonos satellite image; land cover map adapted from Hartung-Hoffmann 2015)



number of households at risk. Massey et al (2010) found that when residents decide to move downhill, the immediate social and economic benefits appear to outweigh the risks from natural hazards. When household survey participants were asked about their homes' vulnerability to floods and landslides, 60% in Ghatichhina and 47% in Thulakhet rated it as high. However, many younger people were not aware that the area was a flood plain before the dam was built and new houses were constructed.

Discussion

The results of our study provide further evidence of the massive outmigration that prevails in the hill regions of Nepal. Of the households surveyed in the Harpan watershed (demographic survey) 71.4% have at least 1 member who has migrated abroad or to elsewhere in Nepal. The low number of men in the watershed has led to a severe shortage of labor, reducing local human capital. The consequences of migration, as documented in this

TABLE 4 Farm size and income sources, 1995–2011. (Sources: Government of Nepal 1996, 2004, 2011)^{a)}

	1995–1996	2003–2004	2010–2011
Agricultural households with farm size below 0.5 ha	39.9%	44.8%	52.7%
Household income sources			
Farm income	61%	48%	28%
Off-farm income	22%	28%	37%
Remittances	16%	11%	17%
Own housing consumption		10%	16%
Other		4%	2%

^{a)} Shares of household income may not sum up to 100 because of rounding.

case study, are important as there is no sign of reversal of the migration trend (Government of Nepal 2014a) or of enhanced development in the villages, which, as respondents said, would enable more people to stay.

The main motives for migration expressed by study participants were economic, which is no surprise. But our results also suggest that the most destitute people—the poorest and those with ill health—cannot afford to migrate, which means that migration as a strategy for improving their situation does not work. Eradicating extreme poverty thus needs specific and targeted measures and policies.

As outmigration from Harpan is high, so are remittances. These are mainly used for daily consumption and for education, with only small amounts invested in farming. Agriculture is not seen as a good livelihood, and if better off-farm incomes enable families to stop farming, they do so, a finding confirmed by other studies across Nepal (Hoermann et al 2010; Gartaula et al 2012a; Sunam and McCarthy 2015). This stands in contrast to studies from other countries that have found that remittances are invested in agriculture, including cash crops (McKay 2005; Mendola 2006; Aguilar-Støen et al 2016).

When men migrate, the remaining family members must manage the household and the land. Women are particularly affected, facing both increased drudgery and increased decision-making responsibilities. They gain confidence in handling these affairs and in managing community life in the absence of men, but constraints remain. Women cannot, for cultural reasons, take over certain tasks, such as plowing, and there is a shortage of male laborers who could do it for them. This may help explain the decrease in the size of farms and farm income, which is compensated for by increasing off-farm income, including remittances (Table 4)—a trend observed in similar mountain contexts worldwide, for example, in East Asia (Rigg et al 2016). This development threatens to erode the local production base and increases dependency on external food sources. The clearest signs

of the lack of labor are abandonment of 36% of the terraced cropland in the upper part of the watershed and reduction in the number of crops. A similar trend has been noted in research on other areas of Nepal, with land abandonment reaching 17.9% in Kabre District and 28% in Lamjung District (Paudel et al 2012, cited by Tamang et al 2014).

Uphill land abandonment is exacerbated by downhill migration within the watershed, involving 18% of the households surveyed (household survey). People move downhill in stages when livelihoods permit (Thieme and Wyss 2005); this move from rural to rural and from rural to urban often involves whole families and thus has a substantial impact on uphill land management and landscapes.

Internal migration to the valleys has its own risks, as shown by the flood of 2015. This disaster, one of several in recent decades, illustrates the trade-offs between opportunities and risks. This study did not investigate why people build and farm in flood-prone areas—whether it is due to lack of awareness, lack of other options, or the fact that the perceived social and economic benefits outweigh the risks. What our study found, though, was that people living in the flood-prone area are aware of the vulnerability of their homes and fields—with the exception of some younger people.

Further studies of the area's flood hazard and of people's awareness of it could help enable land-use planning that meets the demand for land for a growing downhill population. Planning would have to include hazard mapping, especially identification of settlement exclusion zones, as well as raising awareness of hazards. Land accessibility should be explored, as it may be a reason why people settle and farm in hazard-prone areas. Sound land-use planning is needed to address the effects of downhill population movements and provide safer livelihoods for people migrating within the middle hills of Nepal.

This study has several limitations. The Sustainable Livelihoods Framework, which guided the design of the survey, does not cover the institutional aspects of livelihoods. This is an important shortcoming, and future research on institutions and governance could greatly contribute to a better understanding of the effects of migration on land and people. In addition, more research should be done on socioeconomic differentiation within the watershed. Although we did show the difficulty for the poorest to migrate, we did not cover the difference that may exist between ethnic groups in terms of ability to migrate or vulnerability and resilience to shocks.

In conclusion, this research fits in the frame of the Future Earth vision and especially within the Dynamic Planet theme, which aims to provide knowledge that “includes both natural and social components, interactions between them, and variations and extremes, both globally and regionally” (Future Earth 2016). In the

Harpan watershed, both outmigration and internal migration have led to an imbalance in the local social–ecological system. Signs of this imbalance are the growth of settlement and the intensification of agriculture in the valleys as well as a decrease in land management uphill as exemplified by the abandonment of terraced land.

Nepal's terraced landscapes represent an important cultural heritage. These landscapes are in the process of being replaced by “remittance landscapes,” which tend to

be less diverse. This development is not unique to Nepal but can be observed in many parts of the mountain world. The challenge it poses is twofold: (1) how to develop sustainable forms of land use and settlement in the zones of intensification (often valleys) and (2) how to deal with areas being abandoned (often marginal and uphill lands). The second challenge is likely to be more demanding and require more investment, at least if key elements of the traditional landscape and its use are to be maintained.

ACKNOWLEDGMENTS

This 2-year study (2012–2014) was funded by the Swiss Network for International Studies, based in Geneva, complemented with funds from the Centre for Development and Environment of the University of Bern. We would like to thank the communities in the study area and their people for always

welcoming us with a smile during fieldwork, answering the questionnaires, and participating in the focus group discussions. We also thank the anonymous reviewers for important suggestions and Amanda Morgan and Tina Hirschbuehl for language editing and critical comments.

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